

Why do we need spotters?

- WSR-88D (Doppler Radar) limitations
 - Radar Horizon
 - Beam width vs. Range
- Helps forecasters sharpen their radar interpretation skills
 - By knowing what types of radar signatures produce certain types of severe weather, the warning forecaster will be able to gain valuable lead time with their warnings.
 - Nearly all tornadoes in our region are weak and last for a very short period of time.
 - Real-time verification (adds credibility, enhances public response, and improves warning accuracy)

BOTTOM LINE: You are the most reliable source we have for reporting severe weather!

One of the greatest myths in the weather warning program...

The NWS is probably already aware of this (hail, damage, tornado, etc), so why should I report it?

The Reality....

Many, many times we are not!

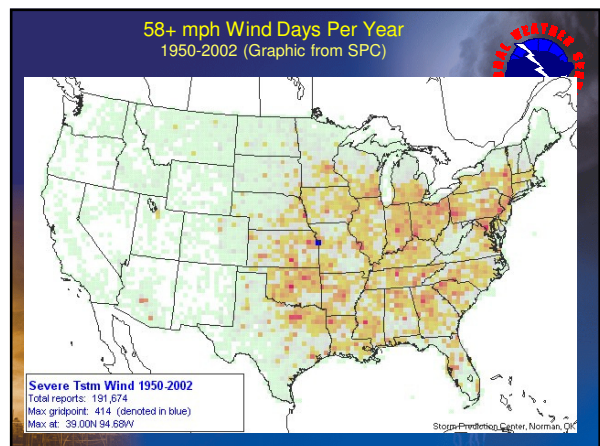
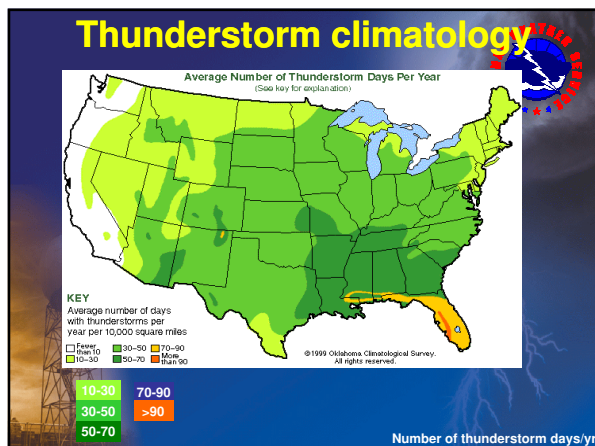
Do not assume that if a warning is issued, the NWS knows for certain that severe weather has occurred. (We want to hear from you!)

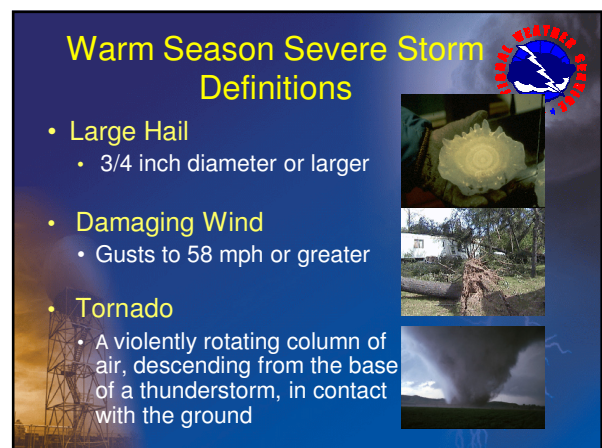
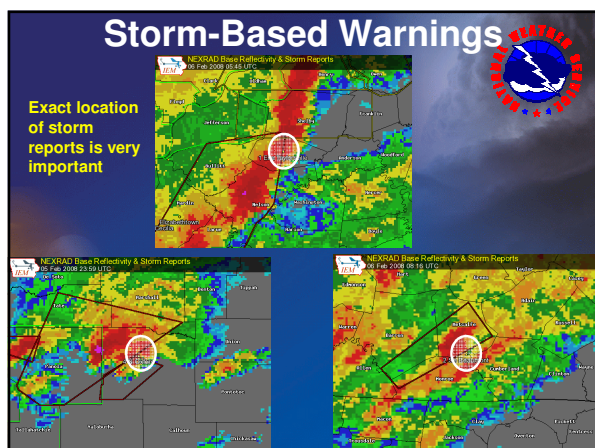
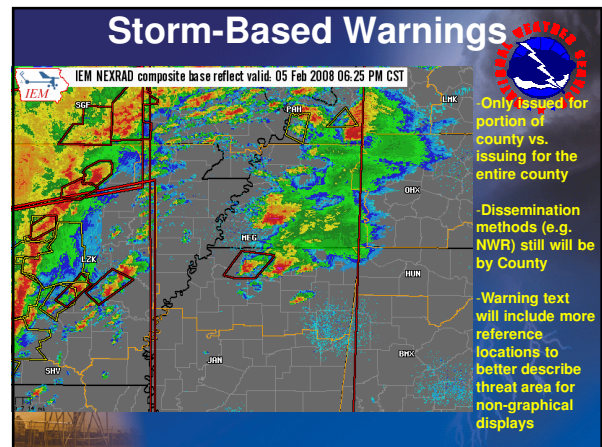
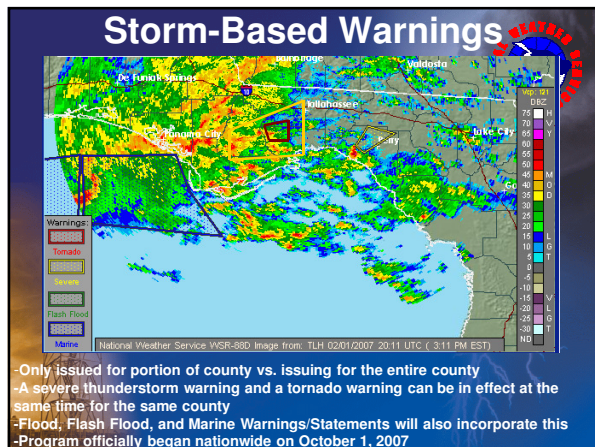
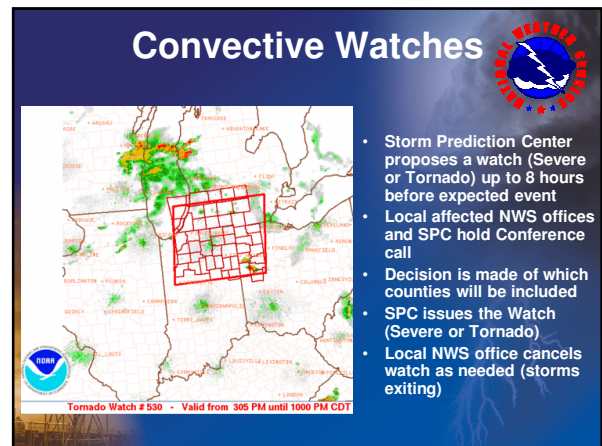
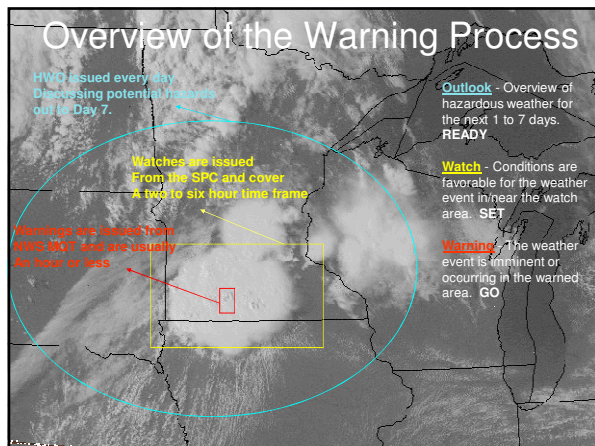
We would be happy to get several reports of the same weather phenomena, than none at all!

We Need You!!!


- Significant weather can occur in the U.P. year round
- NWS Mission - To Protect life and property
- Spotters are the eyes and ears of the NWS
- Spotters + Radar = accurate, timely warnings

U.P. Weather Hazards





Flash Floods



A short-term flood event which requires immediate action to protect lives and property, such as dangerous small stream flooding, rapidly flowing water, urban flooding, and dam or levee failures.



Winter Storm Spotting

What to observe and report...

- **Rapidly Accumulating Snow**
 - Start reporting when accumulations reach 2 inches; then every 2 inches additional snowfall after then
 - Record start/end times of the snowfall, if possible
- **Freezing Rain/Sleet**
 - Report any ice accumulations from freezing rain, especially if the ice reaches 1/4 inch thick
 - Report accumulations of sleet greater than 1/4 inch
- **Reduced Visibilities**
 - Start reporting if visibilities drop to 1/2 mile or less in blowing snow

Summer Storm Spotting



What Information to Relay Immediately

- Tornado, funnel cloud or wall cloud
- Hail - Any size
- Flooding or rainfall of 1+" an hour
- Winds 40+ MPH, damage associated with winds (downed power lines or broken tree limbs 1-2 inches in diameter).

Information to Give the NWS

Hail

- Hail Size - use the following to estimate the size
 - Pea size = 1/4 inch
 - Penny size = 3/4 inch (minimum severe thunderstorm)
 - Quarter size = 1 inch
 - Golf ball size = 1.75 inch
 - Tennis ball size = 2.5 inch
 - Baseball size = 2.75 inch
- Was this the largest size hail that fell?

Volleyball sized hail??

A Tip on Reporting Hail Size

Don't use marble size!



Reference hail size in inches or relate it to the size of a coin.

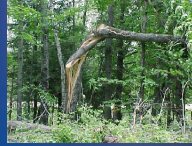
Quarter (1 inch) Nickel Penny (3/4 inch) Dime (11/16 inch)

We don't know how big your marbles are!

Reporting Criteria

Wind

- What type of damage was sustained?
 - If branches were broken off of trees, give the diameter of the largest branches that were broken.
- Can you estimate the strength of the winds?



Estimating Wind Speed

- 25-31 mph - large branches in motion
- 32-38 mph - whole trees in motion
- 39-54 mph - twigs break off, wind impedes walking
- 55-72 mph - damage to chimneys and TV antennas, large branches broken and some trees uprooted
- 73-112 mph - removes shingles, windows broken, trailer houses overturned, trees uprooted
- 113+ mph - roofs torn off, weak buildings and trailer houses destroyed, large trees uprooted



Copyright Mike Umscheid

Reporting Heavy Rain And Flooding

- Rainfall
 - Do you have a rain gage? If so, let us know the specific rainfall amounts
- Is there water over the road?
 - Give the road name and location
- Are there any streams or rivers flooding?
 - Report all flooding immediately
- If no flooding is occurring, start reporting when streams or rivers rise to within 1 foot of bankfull

HOW TO REPORT

- Keep your report brief!
- Identify yourself as a trained storm spotter
- Who, What, When and Where...
- My name is Joe Smith and I am a trained spotter in Menominee County. At 705 PM...I saw a tornado crossing Highway 41 north of Menominee. The tornado was moving northeast. Numerous trees have been knocked down by the tornado.

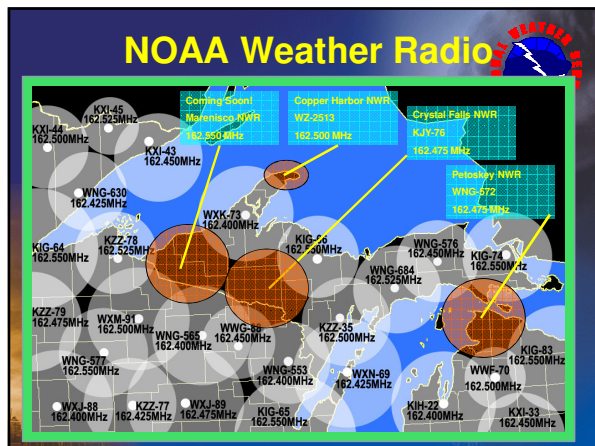
Reporting the Storm

Direct to the National Weather Service

- Call 906-475-5212 (Public Line)
 - This number rings directly in the operations area; press "0" when the recording starts
- Through HAM Radio (WX8MQT)
 - SKYWARN Net usually activated for severe thunderstorm or tornado watch
- Via our webpage (weather.gov/mqt)

How to Receive Weather Information





www.weather.gov/mqt

- **Watches, Warnings, and Advisories**
- **Radar**
- **Gridpoint Forecast**
- **Observations**
- **Text Products**
- **Links to Weather Information**
- **Submit a Report**

Radar Data Online

www.weather.gov/mqt

- **Reflectivity**
 - Base (Lowest Elevation)
 - Composite (Maximum)
- **Velocity (Winds)**
 - Storm Relative
 - Base (Lowest Elevation)
- **Rainfall**
 - One Hour Total
 - Storm Total

Severe Storm Spotting

- **Storm Formation**
 - Conditions needed for storm development
 - Thunderstorm life cycle
 - Thunderstorm classification
- **Severe Storm Identification**
 - Visual clues to storm intensity
 - Upper level clues
 - Mid level clues
 - Low level clues

What 3 things do thunderstorms need in order to develop?

- **Moisture**
- **Instability**
- **Lift**

Moisture

Instability

How atmosphere becomes stable or unstable

Unstable

Warm air rises mixing with cool air causing atmosphere to become unstable

Stable

Cool air near surface doesn't rise so mix with warm air

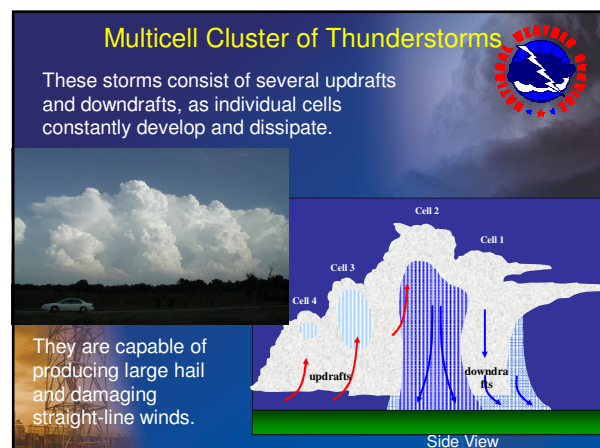
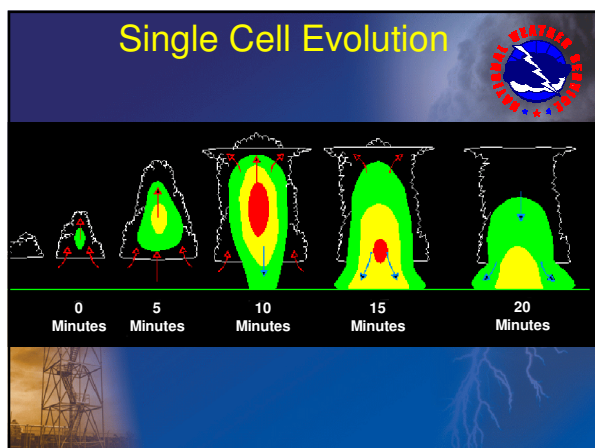
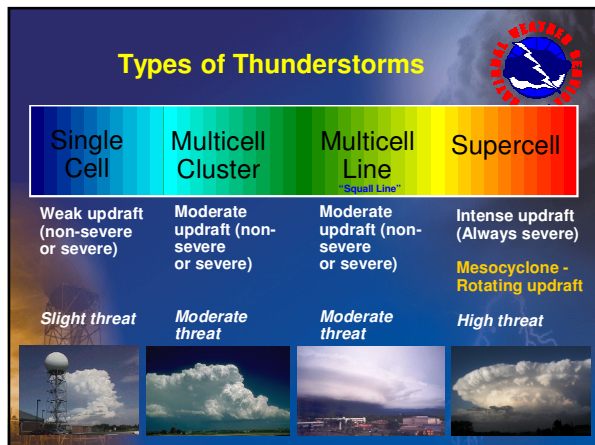
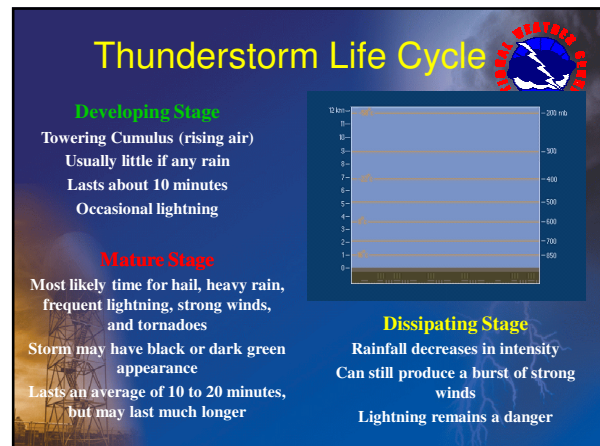
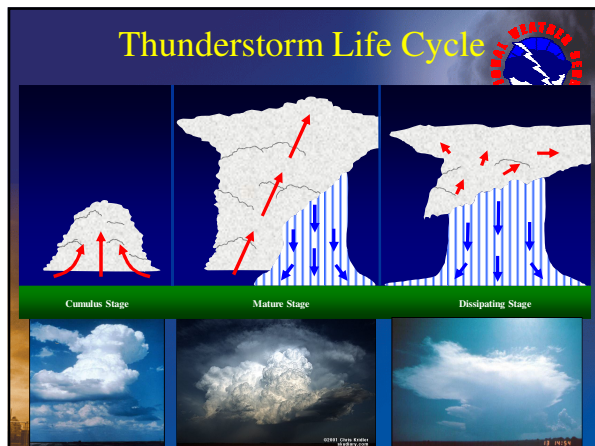
Lift associated with fronts, outflow boundaries, lake breezes, etc.

Cold Front

Cold Air
Warm Air
Warmer Air

Warm Front

Cold Air
Warm Air
Warmer Air

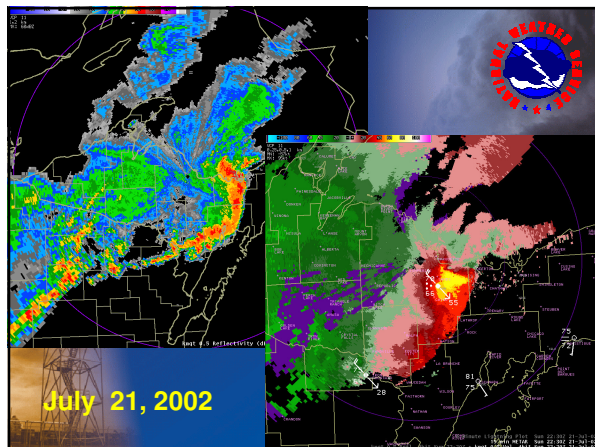


Multicell Line of Thunderstorms (Squall Line)

A line of thunderstorms capable of producing severe weather in the form of high winds, large hail and isolated tornadoes.

Squall Line

- The 'worst is first'. Strong winds will be followed by heavy rains.
- Onset of strong winds are signaled by the shelf cloud



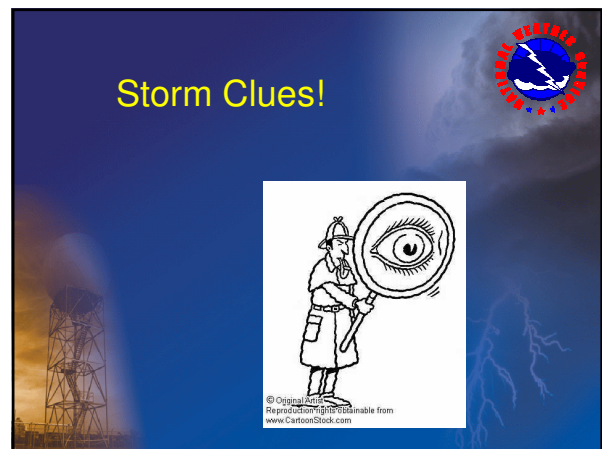
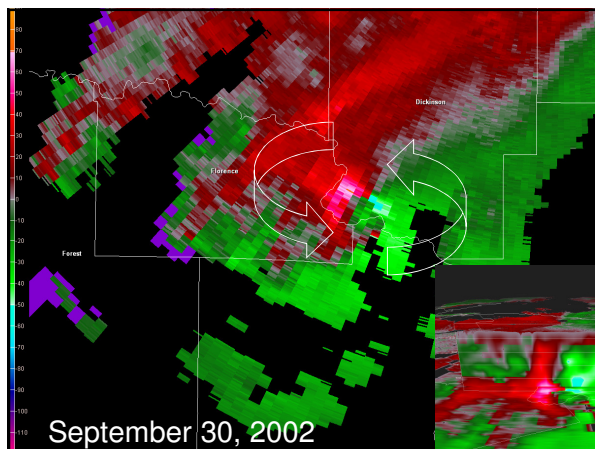
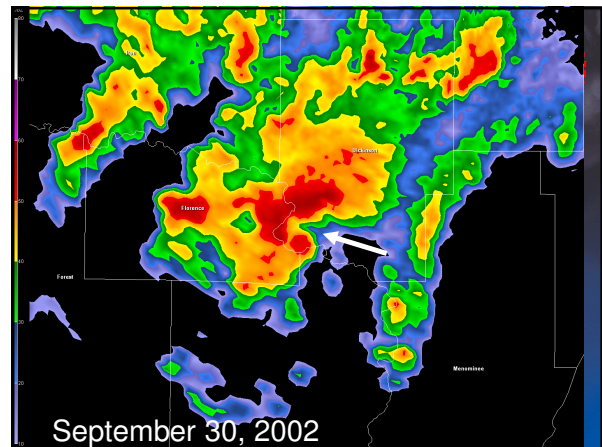
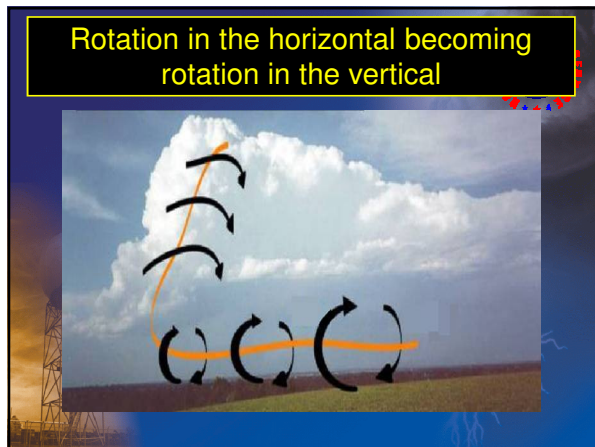
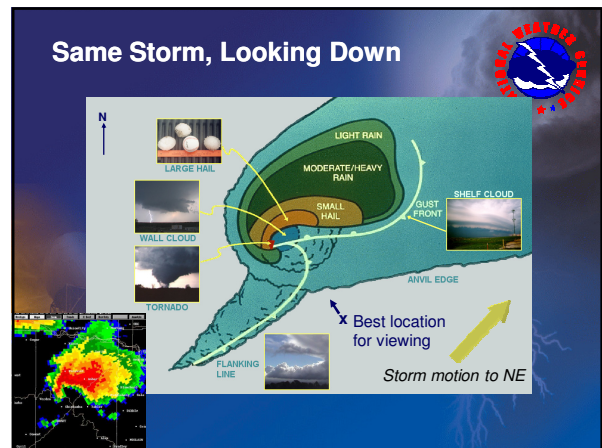
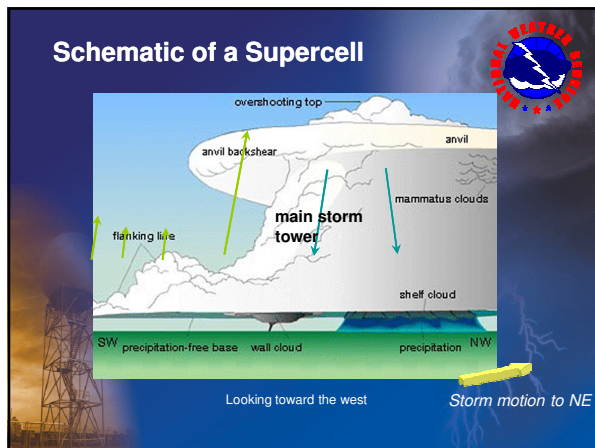
Supercell Thunderstorms

Supercell Thunderstorms Are...

- Highly Organized
- Less than 5% of all thunderstorms
- Long lasting (> 3 hours)
- Almost always associated with severe weather
- Can produce large, violent tornadoes
- Can produce very large hail, damaging downburst winds and flash floods


Copyright Kevin Cox

Supercell Thunderstorm



Upper Level Storm Clues


Best seen 30-40 miles from storm

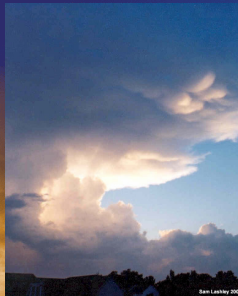


- **Anvil Characteristics**
 - Thick & bubbly with sharp, well-defined edges
- **Overshooting Top**
 - Domelike bubble of cloud material extending above the anvil cloud
- **Back-sheared Anvil**
 - Cloud material pushed against the upper level winds by the thunderstorm updraft


Upper-Level Storm Clues

Best seen 30-40 miles from storm






A Thick & Bubbly Anvil Cloud





Thin & Weak Anvil Cloud

Upper-Level Storm Clues


Best seen 30-40 miles from storm

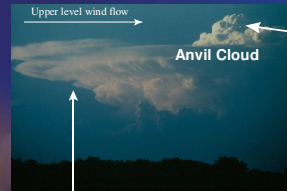


Mature versus Dissipating

Anvil Cloud Characteristics






Upper level wind flow

Anvil Cloud

Back-sheared Anvil




Overshooting Top




Anvil Cloud

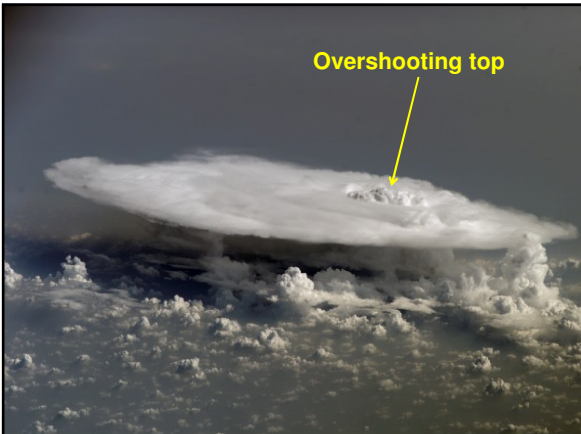
What direction are the upper level winds blowing (left to right or right to left)?

Upper-Level Storm Clues

Best seen 30-40 miles from storm



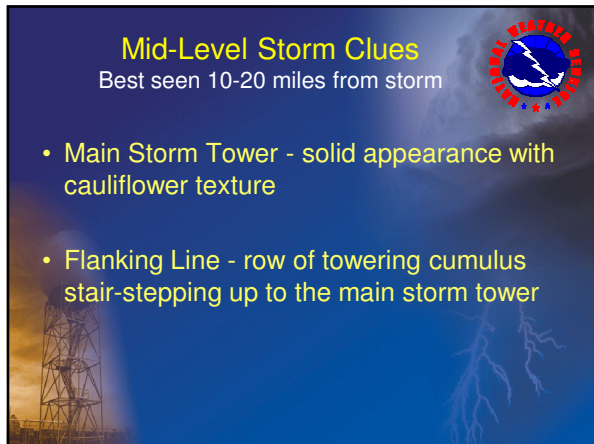



Overshooting top

Mid-Level Storm Clues

Best seen 10-20 miles from storm

- Main Storm Tower - solid appearance with cauliflower texture
- Flanking Line - row of towering cumulus stair-stepping up to the main storm tower



A diagram showing a main storm tower with a cauliflower texture and a flanking line of towering cumulus clouds stair-stepping up to it. A lightning bolt is shown striking the main tower. A small circular logo with a lightning bolt and the text 'SEVERE WEATHER SQUAD' is in the top right corner.

Mid-Level Storm Clues

Best seen 10-20 miles from storm

Striations in mid levels

Flanking line

Photo courtesy of James Correia Jr

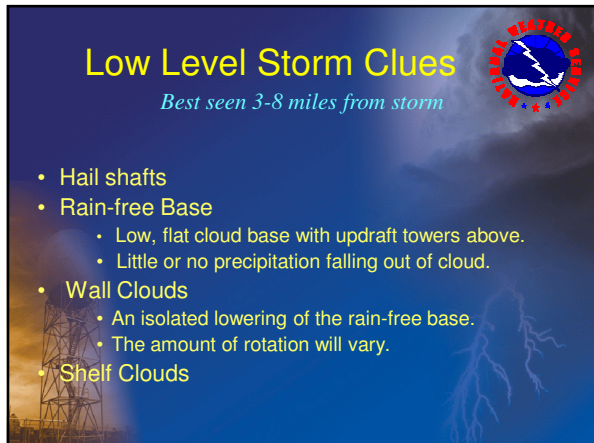


A collage of three photos showing mid-level storm clues. The top left photo shows striations in mid levels. The top right photo shows a flanking line. The bottom left photo shows a lightning tower. A small circular logo with a lightning bolt and the text 'SEVERE WEATHER SQUAD' is in the top right corner.

Low Level Storm Clues

Best seen 3-8 miles from storm

- Hail shafts
- Rain-free Base
 - Low, flat cloud base with updraft towers above.
 - Little or no precipitation falling out of cloud.
- Wall Clouds
 - An isolated lowering of the rain-free base.
 - The amount of rotation will vary.
- Shelf Clouds

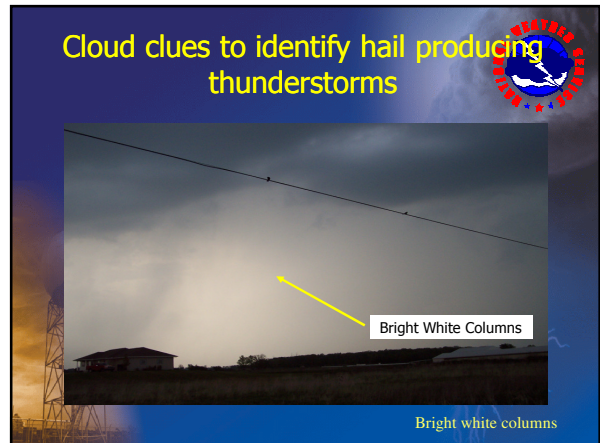


A diagram showing low-level storm clues. It includes a lightning tower, a rain-free base, a wall cloud, and a shelf cloud. A small circular logo with a lightning bolt and the text 'SEVERE WEATHER SQUAD' is in the top right corner.

Cloud clues to identify hail producing thunderstorms


Bright White Columns

Bright white columns



A photo showing a bright white column in a storm cloud. A yellow arrow points to the column. A small circular logo with a lightning bolt and the text 'SEVERE WEATHER SQUAD' is in the top right corner.

Beware of hail shafts!



A collage of photos showing hail shafts. The central photo shows a hail shaft falling from a cloud. Other photos show hail falling from clouds. A small circular logo with a lightning bolt and the text 'SEVERE WEATHER SQUAD' is in the top right corner.

Low Level Clues

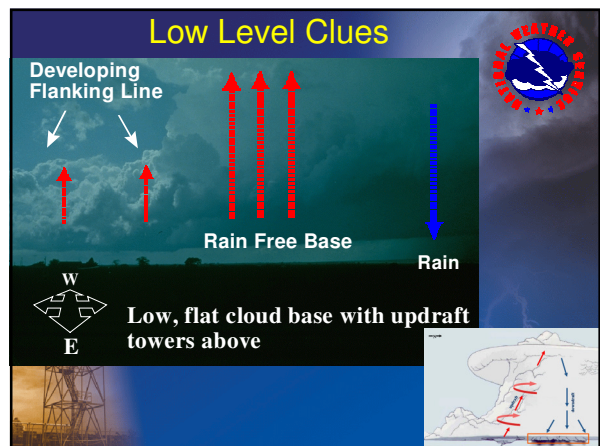
Developing Flanking Line

Rain Free Base

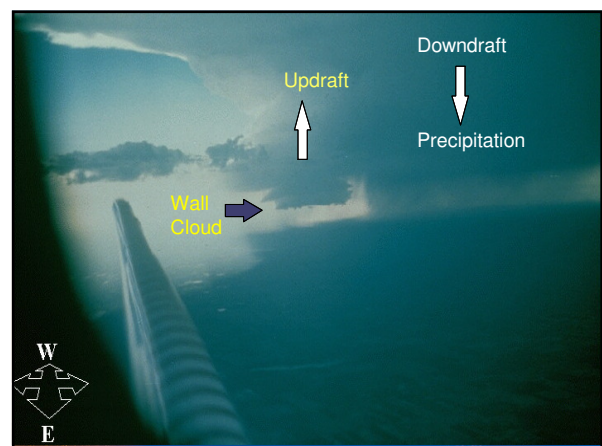
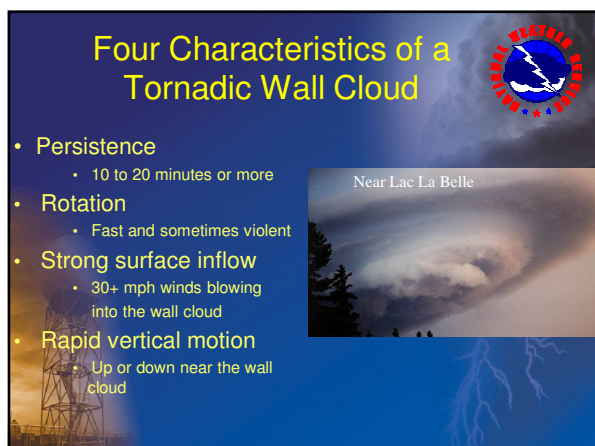
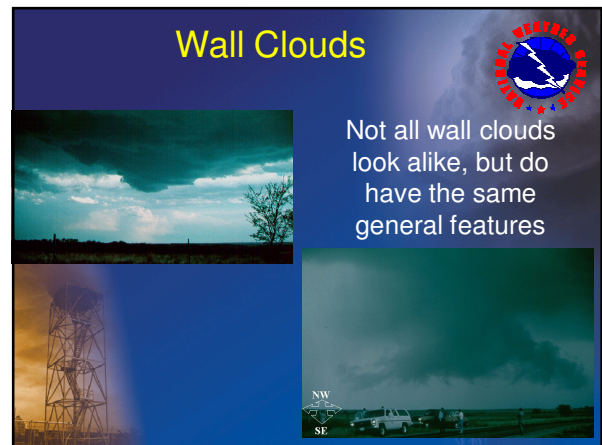
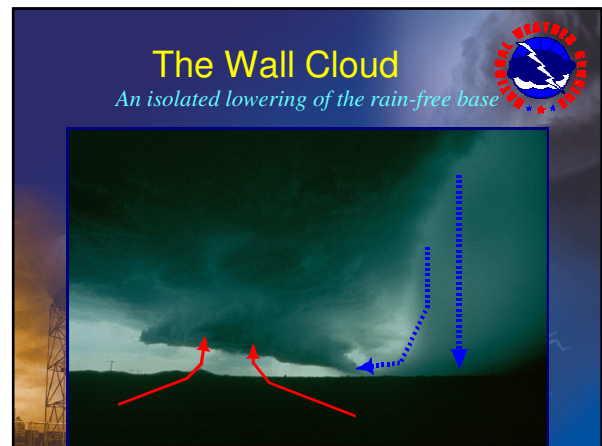
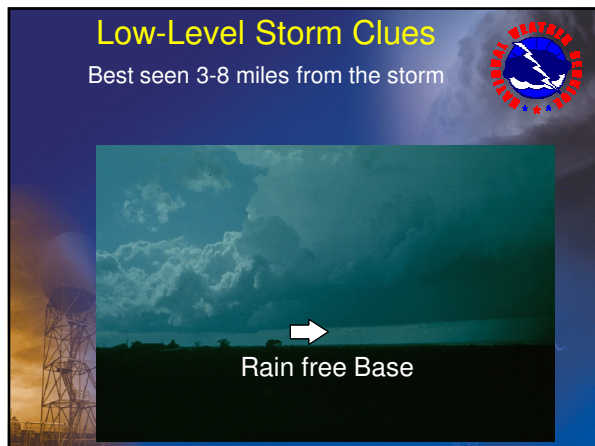
Rain

W E

Low, flat cloud base with updraft towers above



A diagram showing low-level clues. It includes a developing flanking line, a rain-free base, and rain. A compass rose shows West (W) and East (E). A small circular logo with a lightning bolt and the text 'SEVERE WEATHER SQUAD' is in the top right corner.



Tornado vs. Funnel Cloud

- **Tornado:**

- A violently rotating column of air in contact with the ground.
- The visible funnel does not need to reach the ground, just the rotating column of air.



- **Funnel Cloud:**

- A rotating, funnel-shaped cloud not in contact with the ground.
- If funnel is half way to the ground it is probably a tornado.



Funnel Clouds

- Report all funnels
- Character and position to the storm.
- Is there a wall cloud?
- Half-way down? It's probably a tornado.

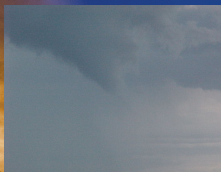
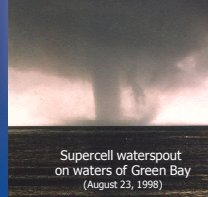


Photo Courtesy Crawford County Iowa EMA

Waterspouts

2 types – 'tornadic' and 'non-tornadic'

- **Tornadic** - A tornado over water associated with a thunderstorm. If these make landfall, they continue on land as a tornado.
- **Non-tornadic** - Typically occur in the early fall as cold air moves over the relatively warm waters of the Great Lakes. They dissipate rapidly upon landfall. These are much more common in Michigan than tornadic waterspouts.



Waterspout near Wells State Park September 29, 2006



Waterspout on the Great Lakes



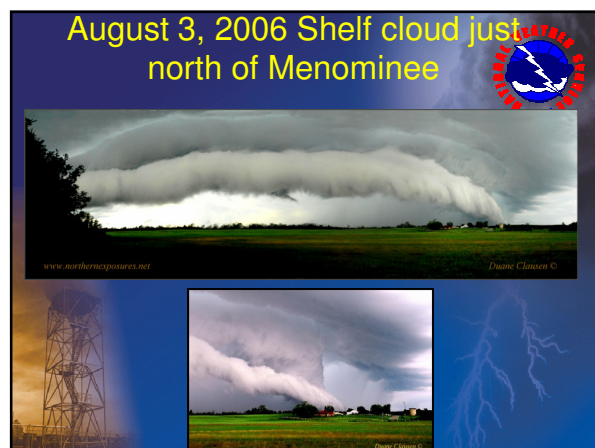
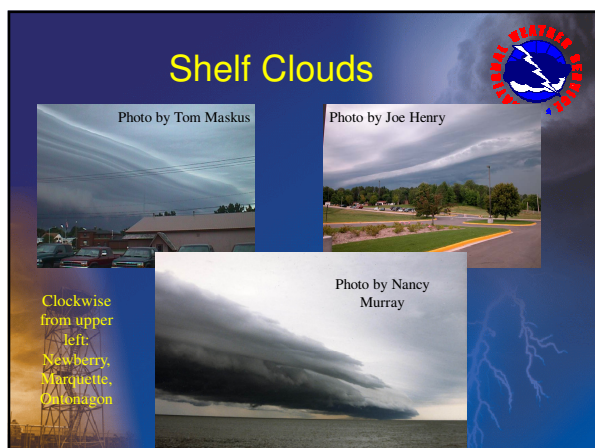
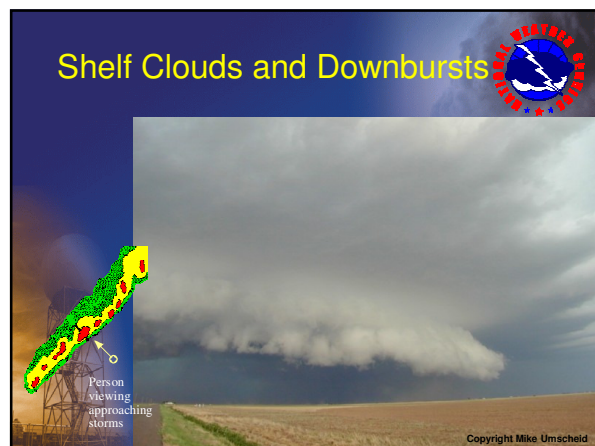
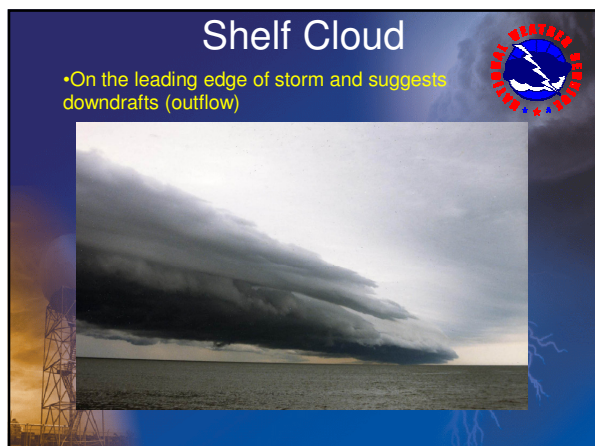
A Key Cloud Feature Associated with Squall Line Thunderstorms

- **Shelf Cloud**


- A low, horizontal wedge-shaped cloud.
- Associated with the storm gust front.
- Attached to the thunderstorm base.
- On the leading edge of the storm.
- Slopes down and away from the precipitation area.



Near Wallace, MI

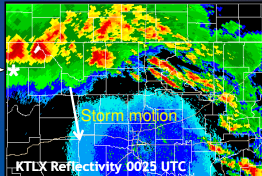


Shelf Cloud



Courtesy Dan Miller


Photo taken here
at 723 pm CDT



Storm motion
KTLX Reflectivity 0025 UTC


Horizontal Roll Cloud

Outflow feature – detached from main cloud



Shelf Clouds



- Suggest downdraft and outflow
- Move away from precip area
- Slopes/points away from precip



Brian Klimowski


Wall Clouds

- Suggest updraft and inflow
- Maintain position with respect to precip area
- Slopes/points toward precip

Quiz

©1992 David Blanchard




Tornado

Funnel Cloud

Wall Cloud

Scud Cloud

Quiz



Wall Cloud


Tornado

Shelf Cloud

Funnel Cloud

Quiz

© 2000 Tim Marshall



Tornado

Funnel Cloud

SCUD Clouds

Wall Cloud

Quiz

© 2002 Dave Lewison

Rain Shaft
 Wall Cloud
 Tornado
 Shelf Cloud

Quiz

Union Bay, Ontonagon County.

Rain Shaft
 Wall Cloud
 Tornado
 Shelf Cloud

Quiz

Cumulus cloud
 Supercell with Wall cloud
 Tornado
 Shelf Cloud

Quiz

Rain Shaft
 Wall Cloud
 Tornado
 Shelf Cloud

Quiz

Scud Clouds
 Wall Cloud
 Funnel Cloud
 Shelf Cloud

Quiz

Tornado
 Smoke
 Heavy Rain/ SCUD
 Shelf Cloud

Quiz

Lone Tree, IA May 15, 1998
©1998 Brian Jewett

Scud Clouds
Funnel Cloud

Wall Cloud
Tornado

Quiz

Copyright © 2004 - John C. Otten

Scud Clouds
Funnel Cloud

Wall Cloud
Mammatus Clouds

Quiz

Manistique, October 1997

Scud Clouds
Tornado

Wall Cloud
Shelf Cloud/Roll Cloud

Spotter Preparedness and Safety

- Awareness
 - Know what to expect
- Safety
 - Be an observer, not a participant!

Weather Hazards

Flash Flooding

Automobiles
Nighttime

Flash Flood Safety

Forces on Vehicles From High Water

The car will be carried when buoyancy force exceeds vehicle weight.

There is no hidden force under the vehicle is that of the water.


Heavy half of all flood fatalities are vehicle related.

Flash Flood Safety

DO NOT drive across a flooded roadway or low water crossing.

If your vehicle stalls in high water, leave it and seek higher ground.

Be especially careful at night, when flash floods are more difficult to recognize.



Flooding in Evansville Sept. 2004 - Keri Connor




The washout on the left is a good example of why one should not drive through water-covered roads.




School bus stuck in flood waters just south of Marion, IL. (Continuation of the Marion-Pike Roadblock.com)

Lightning Is A Big Threat!





- Warnings are not issued for lightning...
- All thunderstorms contain lightning

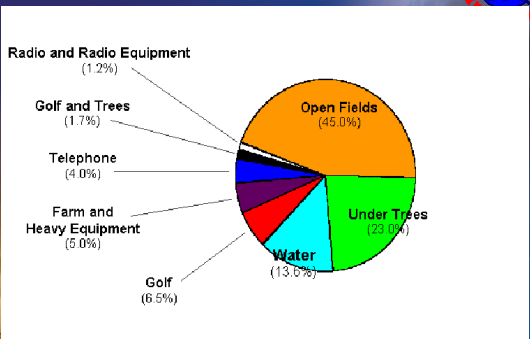


LIGHTNING

- If you can hear thunder, you are close enough to be struck by lightning.
- Air near a lightning strike is heated to 50,000 deg F.

Where do most lightning deaths occur?



Location	Percentage
Open Fields	45.0%
Under Trees	23.0%
Water	13.6%
Golf	6.5%
Farm and Heavy Equipment	5.0%
Telephone	4.0%
Golf and Trees	1.7%
Radio and Radio Equipment	1.2%




Weather Hazards

Lightning Safety Tips

Lightning tends to strike the tallest object in an area...make sure it is not you!

Remain in your vehicle whenever possible.

If you must go outside, crouch down to make yourself a poor lightning target.






Weather Hazards

Lightning Safety Tips

"30-30 Rule"

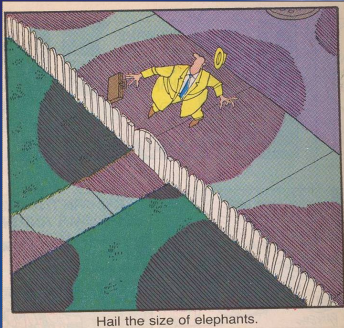
- **30 Seconds:**
Count the seconds between seeing lightning and hearing thunder. If this time is less than 30 seconds, lightning is still a potential threat. Seek shelter immediately.
- **30 minutes:**
After the last lightning flash, wait 30 minutes before leaving shelter. Half of all lightning deaths occur after the storm passes. Stay in a safe area until you are sure the threat has passed.



Bill McCaul

Weather Hazards

Hail

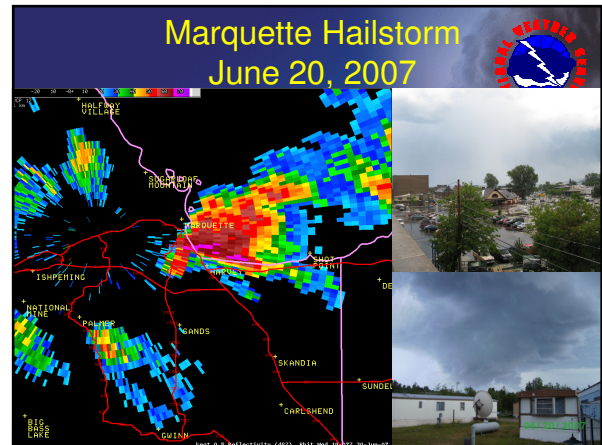
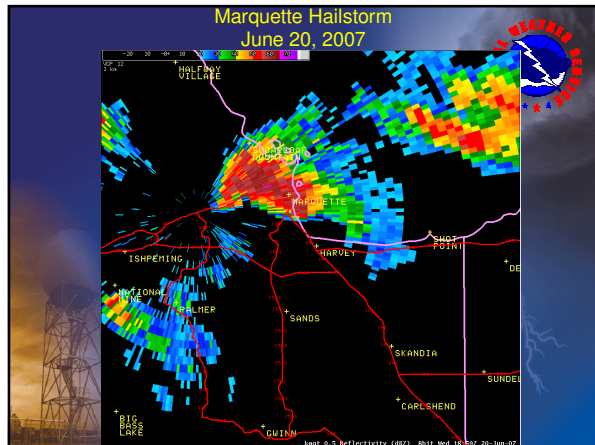


Hail the size of elephants.

Weather Hazards

Hail

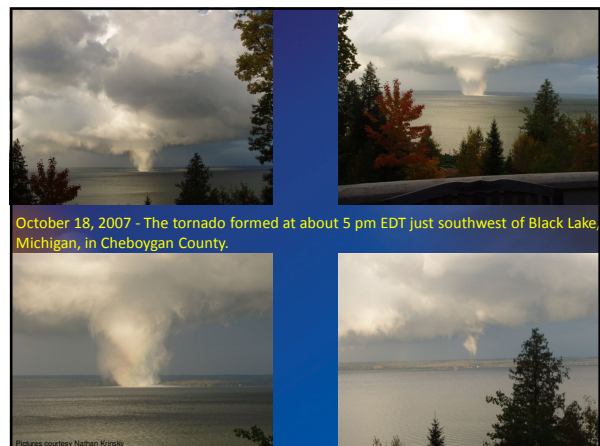
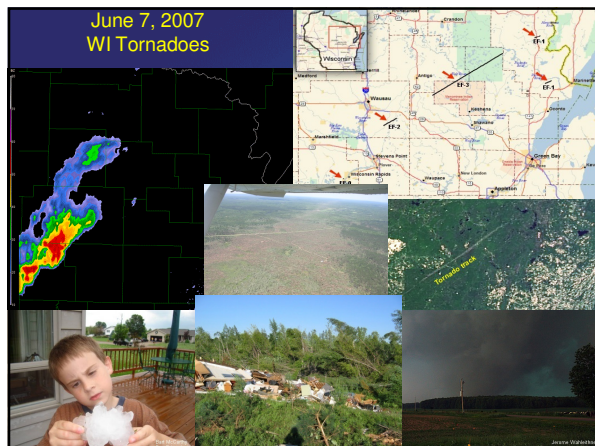
Baseball size hail can do severe damage.

Weather Hazards

Hail Safety Tips

- Substantial structures offer the best hail protection. Stay away from windows!!!
- Your vehicle will provide some protection for hail smaller than golf ball size



Tornado Safety - Have a Plan!

Before The Storm Hits

- Develop a Plan for your family
- Have frequent drills
- Keep a highway map nearby for tracking the location of the storm
- Have an All Hazards NOAA Weather Radio with battery power

Tornado Safety

- Interior room on the lowest floor
- Cover yourself with blankets to protect yourself from flying debris/glass
- In cars and mobile homes, get out and find a more substantial shelter
 - Do not take cover beneath an overpass
- If you can't find a structure, squat low to the ground on the balls of your feet (i.e. ditch)

Tornado Safety - Caught in your car?

- Do NOT try to outrun a tornado - leave your car
- Lie flat in a nearby ditch or depression
- Avoid underpasses

Cars are not safe in a tornado!

Weather Hazards

Overpasses

Overpasses turn deadly in tornadoes


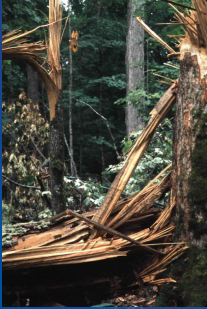
2 When tornado winds squeeze under the overpass they increase as much as 25 percent.

Tornado Safety Rules

- Do not take shelter beneath an overpass!

Downburst Winds

- Winds of 50 knots (58 mph) or greater are severe!
- The most common cause of wind damage!

Damage Path

Tornado

- Convergence
- Narrow, well-defined track
- Rotation about a vertical axis

Downburst

- Divergence
- Broad, diffuse track
- No rotation, or rotation about a horizontal axis




Tornado Path

Damage is convergent




The Enhanced Fujita Scale

Tornadoes are classified according to the intensity of damage they cause to objects.

SCALE	MPH	EXPECTED DAMAGE
EF0	UP TO 85	LIGHT
EF1	86-109	MODERATE
EF2	110-137	CONSIDERABLE
EF3	138-167	SEVERE
EF4	168-199	DEVASTATING
EF5	200-234	INCREDIBLE

Photo by: Mary Hurley

Last F-5 Tornado in Michigan




Video by Eugene Dohm

Hudsonville/Standale April 3, 1956

Downburst

Monroe Co. - June 1998





Minocqua, WI - July 1999

Damage strewn in a more divergent pattern

Do you have a home weather station?

- If so, you can join the Citizen's Weather Observing Program!
 - CWOP allows those with a home weather station to send in weather data (via APRS or the internet) that is available to the NWS every hour and is also incorporated into forecast models.

- The web address:
<http://www.wxqa.com/>



If you are interested in CWOP, please let us know!

Please send us your weather pictures and movies



- We are always looking for new local material for the Storm Spotter presentation
- If you have a cell phone that can take pictures and see an interesting weather photo, please send it along
- Go to www.weather.gov/mqt and send it to the webmaster via the link at the bottom of the first page.

